What is Claim d is:

1	 A device for a precision alignment of a write el m nt on a tape h ad with a
2	transport direction of a media that is transported across the tape head and having
3	opposed edges, comprising:
4	
5	at least one alignment element cofabricated with the write element so that
6	both the write element and the alignment element have a first fixed orientation with
7	respect to a magnetic axis of the tape head,
8	·
9	the write element and the alignment element are adapted to generate a
10	magnetic field induced by a write current supplied to the tape head,
11	
12	the magnetic field from the write element is operative to write a plurality of
13	write transitions on the media thereby defining a write band thereon,
14	
15	the magnetic field from the alignment element is operative to write a plurality
16	of alignment transitions on the media thereby defining an alignment band thereon,
17	the alignment transitions have a recorded orientation with respect to the transport
18	direction, and
19	•
20	wherein the precision alignment is obtained by observing the alignment
21	transitions in the alignment band and adjusting a head-to-media angle between the
22	magnetic axis and the transport direction until the recorded orientation of the
23	alignment transitions is indicative of the write element having a preferred orientation
24	with respect to the transport direction.
1	2. The device as set forth in Claim 1, wherein the alignment element is
2	positioned so that the alignment transitions neither interfere with nor overwrite the
3	written transitions and do not occupy an area on the media predesignated for other
4	uses.

predesignated for other uses conforms with a format specification. 2 3 The device as set forth in Claim 3, wherein the format specification is 4. 1 selected from the group consisting of a Liner Tape-Open format, an ULTRIUM 2 format, a TRAVAN format, and a MAGSTAR MP 3570 format. 3 The device as set forth in Claim 1, wherein the written transitions comprise 1 5. servo code that is prerecorded on the media. 2 The device as set forth in Claim 1, wherein the preferred orientation is 1 6. perpendicular to the transport direction. 2 The device as set forth in Claim 6, wherein the head-to-media angle is 90 1 7. degrees when the preferred orientation is perpendicular to the transport direction. 2 The device as set forth in Claim 1, wherein the first fixed orientation of the 1 8. alignment element is colinear with the magnetic axis so that the alignment element 2 is aligned along the magnetic axis. 3 The device as set forth in Claim 1, wherein the first fixed orientation of the 1 9. alignment element is parallel to the magnetic axis and the alignment element has a 2 position that is offset from the magnetic axis. 3 The device as set forth in Claim 1, wherein the alignment element has a 1 10. length that is from about 10 micrometers long to about 300 micrometers long. 2 The device as set forth in Claim 1, wherein the alignment element has a line 1 11. width that is a selected one of less than 1.0 micrometer and greater than or equal to 2 1.0 micrometer. 3 The device as set forth in Claim 1, wherein the write element has a first line 1 12. width and the alignment element has a line width that is less than or equal to the 2 HP Docket No.: 10001876-1 Page 35 of 44 Application of Patricta A. Beck et al.

- 3 first line width of the write el ment.
- 1 13. The device as set forth in Claim 12, wherein the first line width of the writ.
- 2 element is a selected one of less than 1.0 micrometer and greater than or equal to
- 3 1.0 micrometer.

- 1 14. The device as set forth in Claim 1, wherein observing the alignment
- 2 transitions comprises applying a magnetically reactive material to the media to
- 3 render the alignment transitions visible so that the recorded orientation of the
- 4 alignment transitions can be visually compared with a reference point to determine if
- 5 the recorded orientation is indicative of the write element having the preferred
- 6 orientation with respect to the transport direction.
- 1 15. The device as set forth in Claim 14, wherein the magnetically reactive
- 2 material comprises a material selected from the group consisting of ferromagnetic
- 3 particles and ferrofluid.
- 1 16. The device as set forth in Claim 14, wherein the reference point is any
- 2 selected one of the opposed edges and the transport direction.
- 1 17. The device as set forth in Claim 1, wherein observing the alignment
- 2 transitions comprises using a separate read head positioned in fixed relation to the
- 3 tape head, the read head including a first read element adapted to generate a first
- 4 read signal from the alignment transitions in the alignment band as the media is
- 5 transported across the read head, and

- 7 wherein the head-to-media angle is adjusted until the first read signal
- 8 matches a predetermined signature that is indicative of the recorded orientation
- 9 having a preferred alignment with respect to the transport direction such that the
- 10 predetermined signature is also indicative of the write element having the preferred
- orientation with respect to the transport direction.

1	18. The device as set forth in Claim 17, wherein the preferred alignment is	
2	perpendicular to the transport dir ction.	
1	19. The device as set forth in Claim 17, wherein the read head further comprises	;
2	a second read element adapted to generate a second read signal from the	
3	alignment transitions in an adjacent alignment band as the media is transported	
4	across the read head, and wherein the predetermined signature comprises the first	
5	and second read signals occurring nearly simultaneously in time within a specified	
6	tolerance.	
1	20. The device as set forth in Claim 1, wherein the alignment element is spaced	
2	apart from another alignment element by a first variable pitch.	
1	21. The device as set forth in Claim 1 and further comprising:	
2		
3	a first gross alignment pattem including at least one horizontal element and	
4	positioned at a first end of the magnetic axis;	
5		
6	a second gross alignment pattern including at least one horizontal element	
7	and positioned at a second end of the magnetic axis,	
8		
9	the horizontal elements of the first and second gross alignment patterns are	ţ
10	cofabricated with the write element and the alignment element and each horizonta	ı
11	element has a second fixed orientation with respect to the magnetic axis,	
12		
13	wherein as the media is transported across the tape head a first one of the	
14	opposed edges is adjacent to the first gross alignment pattern and the horizontal	
15	element thereof is visible outside the first one of the opposed edges and a second	
16	one of the opposed edges is adjacent to the second gross alignment pattern and t	
17	horizontal element thereof is visible outside the second one of the opposed edges	,

18

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and -

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6	
5	with the horizontal element, and
4	a vertical element that is colinear with the magnetic axis and is cofabricated
3	
2	alignment patterns further comprise:
1	27. The device as set forth in Claim 21, wherein the first and second gross
4	with the media.
3	opposed edges are used for adjusting the tape head to visually center the tape hea
2	first and second gross alignment patterns that are visible outside of their respective
1	26. The device as set forth in Claim 21, wherein the horizontal elements in the
3	wide to about 1.0 millimeters wide.
2	first and second gross alignment patterns have a width from about 50 micrometers
1	25. The device as set forth in Claim 21 wherein the horizontal elements of the
3	less than 1.0 micrometer and greater than or equal to 1.0 micrometer.
2	first and second gross alignment patterns have a height that is a selected one of
-1	24. The device as set forth in Claim 21 wherein the horizontal elements of the
2	range from about 20 micrometers to about 200 micrometers.
1	23. The device as set forth in Claim 22, wherein the second variable pitch is in a
3	alignment patterns by a second variable pitch.
2	apart from another horizontal element in their respective first and second gross
1	22. The device as set forth in Claim 21, wherein the horizontal element is spaced
25	
24	be repositioned to conceal the visible horizontal elements.
23	the opposed edges and subsequent to the gross visual alignment the tape head can
22	or both of the horizontal elements is parallel to its respectiv first or s cond on of
21	transport direction is obtain d by adjusting the head-to-media angl until either on
20	wherein a gross visual alignment between the magnetic axis and the

7	wherein at I ast a portion of the vertical elements in the first and second	
8	gross alignment patterns are visible outside their respective opposed edges so that	
9	both vertical el ments serve as an accurate visual indication of the location of th	
10	magnetic axis relative to the transport direction and the gross visual alignment	
11	between the magnetic axis and the transport direction is obtained by adjusting the	
12	head-to-media angle until either one or both of the vertical elements has a preferred	
13	edge orientation with its respective first or second one of the opposed edges.	
14		
1	28. The device as set forth in Claim 27, wherein the preferred edge orientation is	
2	perpendicular to the opposed edges.	
1	29. The device as set forth in Claim 27, wherein the vertical element has a line	
2	width that is from about 0.5 micrometers wide to about 3.0 micrometers wide.	
1	30. The device as set forth in Claim 27, wherein each of the alignment elements	
2	has a second line width and the vertical element has a third line width that is greater	
3	than or equal to the second line width.	
1	31. The device as set forth in Claim 1 and further comprising:	
2		
3	at least one read element that is cofabricated with the write element and the	
4	alignment element, the read element is aligned with the alignment element so that	
5	the alignment transitions pass over the read element as the media is transported	
6	across the tape head in the transport direction,	
7		
8	the read element is adapted to generate a read signal in response to the	
9	alignment transitions, and	
10	the state of the seed planel in	
11	the read signal is analyzed to determine if a magnitude of the read signal is	
12	indicative of a successfully written alignment transition.	
1	32. The device as set forth in Claim 31, wherein the write current to the alignment	nt
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- elem nt is increased when the magnitude of the read signal is not indicative of a succ safully written alignment transition.
- 1 33. The device as set forth in Claim 1, wherein the tape head is a component selected from the group consisting of a closed-loop servo head, a thin-film magnetoresistive head, and a thin-film magnetoresistive servo-write head.
- 1 34. The device as set forth in Claim 1, wherein the write element has a shape 2 selected from the group consisting of a full chevron pattern, a partial chevron 3 pattern, a full diamond pattern, and a partial diamond pattern.
- 1 35. The device as set forth in Claim 1, wherein the alignment element is positioned so that the alignment transitions occupy an area on the media predesignated for other uses.
- 1 36. The device as set forth in Claim 35, wherein the area on the media 2 predesignated for other uses conforms with a format specification.
 - 37. The device as set forth in Claim 35, wherein the media is transported across a separate data head in a direction of transport, the data head including a plurality of data elements formed along a magnetic axis of the data head, each of the data elements is adapted to generate a data signal in response to the alignment transitions that pass over that data element, the alignment transitions are prerecorded on the media and have the preferred alignment with respect to the transport direction, and

wherein a precision alignment between the data head and the direction of transport is obtained by analyzing the data signals from at least two of the data elements and adjusting a data-head-to-media angle between the magnetic axis and the direction of transport until the data signals match a signature that is indicative of the data head having a preferred azimuth angle with respect to the direction of transport.

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1	38. The device as set forth in Claim 37, wherein the data head further compris s
2	at least one write element that is formed along the magnetic axis and both the write
3	element and the data lements ar aligned with the direction of transport when the
4	data head has the preferred azimuth angle with respect to the direction of transport.
1	39. A device for gross visual alignment of a write element of a tape head with a
2	transport direction of a media that is transported across the tape head and having
3	opposed edges, comprising:
4	
5	a first gross alignment pattern including at least one horizontal element and
6	positioned at a first end of a magnetic axis of the tape head;
7	
8	a second gross alignment pattem including at least one horizontal element
9	and positioned at a second end of the magnetic axis,
10	·
11	the horizontal elements of the first and second gross alignment patterns are
12	cofabricated with the write element and each horizontal element has a second fixed
13	orientation with respect to the magnetic axis,
14	·
15	the write element is adapted to generate a magnetic field induced by a write
16	current supplied to the tape head and the magnetic field is operative to write a
17	plurality of write transitions on the media thereby defining a write band thereon,
18	
19	wherein as the media is transported across the tape head a first one of the
20	opposed edges is adjacent to the first gross alignment pattern and the horizontal
21	element thereof is visible outside the first one of the opposed edges and a second
22	one of the opposed edges is adjacent to the second gross alignment pattern and the
23	horizontal element thereof is visible outside the second one of the opposed edges,
24	and
25	
26	wherein the gross visual alignment of the write element with the transport
27	direction is obtained by adjusting a head-to-media angle between the magnetic axis
28	and the transport direction until either one or both of the horizontal elements is

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1	40. The device as set forth in Claim 39, wh rein the first and second gross
2	alignment patterns further include a plurality of horizontal elements and the
3	horizontal elements are spaced apart by a second variable pitch.
1	41. The device as set forth in Claim 39, wherein the horizontal elements in the
2	first and second gross alignment patterns that are visible outside of their respective
3	opposed edges are used for adjusting the tape head to visually center the tape head
4	with the media.
1	42. The device as set forth in Claim 39, wherein the first and second gross
2	alignment patterns further comprise:
3	
4	a vertical element that is colinear with the magnetic axis and is cofabricated
5	with the horizontal element, and
6	
7	
8	wherein at least a portion of the vertical elements in the first and second
9	gross alignment patterns are visible outside their respective opposed edges so that
10	both vertical elements serve as an accurate visual indication of the location of the
11	magnetic axis relative to the transport direction, and
12	
13	wherein the gross visual alignment of the write element with the transport
14	direction is obtained by adjusting the head-to-media angle until either one or both of
15	the vertical elements has a preferred edge orientation with its respective first or
16	second tape edge.
1	43. The device as set forth in Claim 42, wherein the preferred edge orientation is
2	perpendicular to the opposed edges.
1	44. A device for using at least one data element of a data head for a precision
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parallel to its respective first or s cond one of the opposed edges.

2	alignment of the data h ad with resp ct to a direction of transport of a media that is
3	transported across the data head, comprising:
4′	
5	a plurality of alignment transitions prerecorded on the m dia in an alignm nt
6	band with a preferred alignment with respect to the direction of transport,
7	
8	the data element is adapted to generate a data signal in response to the
9	alignment transitions that pass over the data element as the media is transported
10	across the data head in the direction of transport; and
11	
12	an azimuth control unit for adjusting an azimuth angle between the data head
13	and the direction of transport, the azimuth control unit receives the data signal and
14	is connected with the data head, and
15	
16	wherein the precision alignment is obtained by analyzing the data signal and
17	adjusting a data-head-to-media angle between the data head and the direction of
18	transport until the data signal matches a signature that is indicative of the data head
19	having a preferred azimuth angle with respect to the direction of transport.
4	45. The system as set forth in Claim 44, wherein the preferred azimuth angle is
1	perpendicular to the direction of transport.
2	perpendicular to the direction of transport.
1	46. The system as set forth in Claim 44, wherein the data element is adapted to
2	generate a magnetic field in response to a data current supplied to the data head
3	and the magnetic field is operative to overwrite at least a portion of the alignment
4	transitions with a plurality of data transitions.